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PATENT SPECIFICATION 842,334

DRAWINGS ATTACHED.

Inventor: CECIL EDWIN DOBLE.

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COMPLETE SPECIFICATION.

Improvements in or relating to Fixing Devices for Attaching Objects to Concrete Walls, Ceilings and the like.

We, TRUSCON LIMITED, formerly THE TRUSSED CONCRETE STEEL COMPANY LIMITED, a British Company, of 35-41 Lower Marsh, London, S.E.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

The present invention relates to fixing devices of the kind comprising a slotted insert in the form of a channel which is adapted to be embedded in concrete beams, columns, walls, ceilings, and the like with its mouth flush with and open to the exposed surface of the concrete and which provides an anchorage for bolt heads, nuts and like devices used for attaching objects to the wall, ceiling or the like in which the channel is embedded.

The invention is concerned with improvements in such slotted inserts and in bolts and nuts for use with them, as well as in fixing devices comprising both the inserts and the bolts or nuts. Among the objects of this invention are to enable a fixing bolt or nut to be easily inserted into the slotted insert and, when inserted, to be easily adjusted to any position along the latter; and to enable the load-carrying capacity of the insert to be made proportional to the carrying capacity of the bolts used therewith, without having to make the insert of unduly large cross-section.

According to this invention, there is provided a slotted insert of the kind referred to having walls which have oppositely disposed regions mutually inclined so as to diverge from one another in the direction away from the mouth of the insert and towards the base thereof to provide divergent inclined supporting surfaces for correspondingly inclined mating surfaces on two opposite sides of a fixing-bolt head or on two opposite sides of a nut into which a fixing bolt is adapted to be screwed. The spacing between the walls of the insert at its mouth is preferably only slightly more than sufficient to allow the shank of the corresponding fixing bolt to pass out through said mouth. For example, this spacing may be between 10% and 30% greater than the diameter of the said shank.

The base of the insert is advantageously shaped so that its maximum depth is in the centre, and in one preferred construction it is of arcuate cross-section.

The walls of the insert may be flanged outwardly at the mouth and then bent back at right angles in the general direction from the mouth to the base of the insert.

A nut for use with this insert has each pair of opposite sides inclined at the same angle as the corresponding inclined wall surface parts of the insert and has the larger end surface recessed coaxially with its screw-threaded bore to receive a conical spiral spring. The combined depth of the nut and spring, when the latter is fully compressed, is slightly less than the width of the mouth of the insert. The nut, with the spring fully compressed, can thus be inserted side-foremost through the mouth of the insert and, when it is near the base end of the insert, turned over and adjusted into a position in which two opposite inclined side surfaces thereof engage the inclined side wall parts of the insert, the smaller diameter end of the spring being adapted to slide over the curved

inside surface of the insert as the nut is turned over.

After being inserted in this manner, the fixing nut or bolt can be slid along the slotted insert to any desired position.

A fixing bolt for use with this insert may be provided with a head of substantially the same width but greater length than the diameter of the shank, the ends of the head being formed with inclined surfaces adapted to engage and mate with the inclined surface wall parts of the insert. This arrangement enables the bolt head, after being turned into a position in which its longer dimension is parallel with the length of the insert, to be introduced into the insert through the mouth of the latter and, when inserted therein to a sufficient depth, to be turned through a substantial angle so that its inclined surfaces can be engaged with those of the insert.

The depth of the slot can be reduced, and the angle through which the bolt must be turned to ensure correct mating of its inclined surfaces with those of the insert can be more easily judged, if the inclined surfaces on the bolt head are disposed so that their top and bottom edges are parallel to one another and at an oblique angle to the sides of the bolt head.

The invention is illustrated by way of example in the accompanying drawings, in which: —

Figures 1 to 4 are vertical sections of a slotted insert embedded in a ceiling and show respectively four successive stages of the introduction of a nut into the insert;

Figure 5 is a perspective view of the nut engaged by a wire tool which is used for holding and manipulating the nut during its introduction into the insert;

Figure 6 is a vertical section illustrating a slotted insert embedded in a building block which is built into a wall;

Figure 7 is a vertical section of a slotted insert with a fixing bolt engaged therein;

Figure 8 is a section on the line VIII — VIII in Figure 7; and

Figures 9 and 10 are a vertical section and a bottom plan view of a slotted insert provided with a cover strip.

The same references are used to indicate like parts in all figures of the drawings.

Referring to Figures 1 to 4, there is embedded in a cast-*in-situ* concrete ceiling 11 a slotted insert in the form of an inverted metal channel having two parallel wall parts 12 extending inward, from the mouth towards the base of the channel, a distance rather greater than the width of the opening between the wall parts 12. Thereafter, the walls of the channel diverge as at 13 at a mutual angle of 35° in the direction towards the base of the channel and for a distance approximately equal to the inwardly extending distance of the wall parts 12 before joining the base 14 of the channel which is of curved cross-section with a concave surface on the inside of the channel, that is the base of the insert is so shaped that its maximum depth is in the centre.

At the mouth of the channel are formed two outwardly directed flanges 15, the outer margins 16 of which are bent back for a short distance in the general direction from the mouth towards the base of the channel.

This slotted insert is embedded in the concrete ceiling 11, so that the lower surfaces of the flanges 15 are flush with the exposed under surface 17 of the ceiling 11. The embedding of the slotted insert in the concrete ceiling 11 in this manner is facilitated by the flanges 15 which enable the insert to be secured tightly by means of clout nails, dog spikes or the like (not shown) against the shuttering (also not shown) upon which the concrete ceiling 11 is cast, the heads of the clout nails, dog spikes or the like engaging over the bent back margins 16 of the flanges 15.

A four-sided fixing nut has all four sides 18 inclined inward from top to bottom at the same angle as the inclined wall parts 13 of the slotted insert. The top edges of the nut are rounded off as at 19 and the centre part of its top surface is recessed to provide an annular seating 21 surrounding its screw-threaded bore 22. Engaged in a lateral undercut in the side of this recessed annular seating 21 is the larger end of a conical spiral spring 23.

In order to facilitate manipulation of this fixing nut during its insertion into the slotted insert, shallow recesses 24 are formed in corresponding positions one in each end of the sloping sides 18, closer to the wider end of the nut than the narrower end thereof, for engagement by projections on jaws, or the like, of a tool. A suitable tool is formed of spring wire bent in the middle to form a one-and-a-half turn coil 25 (Figure 5) from which the end portions of the wire project to form two similarly directed but slightly divergent arms 26 which constitute the jaws of the tool. The extremities of these arms 26 are bent towards one another as at 27 to form the above-mentioned projections for engagement in the recesses 24 in either of the two pairs of opposite sides of the nut.

Having first engaged the projections 27 of the tool in two opposite recesses 24, the nut can be introduced into the slotted insert by first turning it into a position in which its bottom surface is parallel to the wall parts 12 and then, after compressing the spring 23, inserting the nut and spring side-foremost through the mouth of the insert (see Figure 1). During this phase, the bottom surface of the nut will slide up one wall part 12 and the smaller end of the spring 23 up the other wall part 12. On continued movement of the

nut towards the base of the insert, the bottom surface of the nut will slide up one of the inclined wall parts 13 and the spring 23 up the other (see Figure 2). Subsequently, when the nut and its spring 23 are in the widest part of the slot of the slotted insert, the nut can be turned over and adjusted by manipulating the tool into approximately the position shown in Figure 3. Finally, by partly withdrawing the tool so that the spring 23 is allowed to expand, and thereafter if necessary pushing the tool into and out of the slotted insert, the nut will be caused to assume the position shown in Figure 4 in which those two opposite inclined sides thereof which are not engaged by the tool are in mating surface contact with the inclined wall parts of the insert. The curved inner surface of the base 14 of the insert facilitates the sliding movement of the smaller diameter end of the spring 23 from the position in which it is shown in Figure 3 to that in which it is shown in Figure 4.

The nut can now be moved by means of the tool into the required position along the slotted insert, after which the tool is disengaged from the nut and withdrawn.

Although the nut can be slid lengthwise of the slotted insert in the manner just described in order to position it as required, its spring 23 operates to maintain sufficient frictional resistance to such sliding movement to prevent accidental displacement of the nut, e.g. displacement under the action of gravity in the case of the insert being arranged vertically in a wall surface instead of horizontally in a ceiling.

The slotted insert, instead of being embedded in a cast-*in-situ* concrete ceiling or wall, may be embedded in a cast-*in-situ* concrete beam or column. Alternatively, it may be embedded in a building block suitably dimensioned for incorporation horizontally or vertically in brickwork. Such an arrangement is illustrated by way of example in Figure 6 in which a slotted insert 12, 13, 14, 15 is shown embedded in a reinforced concrete building block 31 built into a masonry wall 32 faced with plaster 33.

Figures 7 and 8 shown a ¼in. diameter fixing bolt anchored by its head in a slotted insert constructed and arranged as already described. The head 34 of this bolt has the form of a cross-piece. On both ends of the cross-piece are inclined surfaces 35 which converge in the direction towards the shank 36 of the bolt at the same angle as the inclined wall parts 13 of the slotted insert. These inclined end surfaces 35 are also arranged obliquely so that the top edges of the cross-piece form a parallelogram having two opposite angles of 100° and the other two of 80° (see Figure 8).

In order to engage this fixing bolt 34, 36 in the slotted insert 12, 13, 14, 15, it is first turned until the longer side surfaces 37 of its head are parallel to the wall parts 12 of the slotted insert. The head 34 is then introduced upward through the mouth of the slotted insert and turned with the larger angles of the above-mentioned parallelogram foremost until the inclined end surfaces 35 of the head are parallel with the inclined wall surface parts 13 of the insert. Lastly, the shank 36 is withdrawn axially downward until the inclined end surfaces 35 of the bolt head are seated against the inclined wall parts 13 of the slotted insert (see Figure 7).

The bolt head 34 may, if desired, be provided with a spring (not shown) similar to the spring 23 (Figures 2 to 5) to retain the bolt in position.

Figures 9 and 10 show how the slotted insert described above may be provided with a cover strip indicated generally at 38. This cover strip 38 is secured to the slotted insert by having its longitudinal marginal portions bent up and over the bent back margins 16 as at 39. The cover strip 38 is preferably made of sufficiently thin material to enable it to be cut away as at 41 to enable fixing nuts or the heads 34 of fixing bolts to be inserted through it. End caps (not shown) may be provided to prevent concrete from entering the ends of the insert during casting. The nut shown in broken lines in Figure 9 and on the left of Figure 10 is in the position which it occupies during insertion, while that similarly shown on the right of Figure 10 is in the final position corresponding to that shown in Figure 4.

A high load-carrying capacity is achieved in practice with the slotted inserts described above, due to the fact that the supporting surfaces formed by the inclined wall parts 13 are set back from the exposed surface 17 of the concrete by an amount equal to the distance that the parallel-sided wall parts 12 extend inward from the mouth of the insert in the direction towards the curved wall 14 forming the base of the insert. It is also an easy matter to match the load-carrying capacity of the insert with the strength of the fixing device, i.e. the fixing bolt or fixing nut used therewith.

The longitudinal stiffness of the insert, if the insert is made of a suitable metal, can, moreover, be such as to spread the effect of a load suspended from a fixing bolt or nut over an area of the concrete in which the insert is embedded which is considerably larger than the actual contact area of the nut or bolt head on the supporting surfaces of the insert.

WHAT WE CLAIM IS: —

1. A slotted insert of the kind referred to having walls which have oppositely disposed regions mutually inclined so as to diverge from one another in the direction away from

the mouth of the insert and towards the base thereof to provide divergent inclined supporting surfaces for correspondingly inclined mating surfaces on two opposite sides of a fixing-bolt head or on two opposite sides of a nut into which a fixing bolt is adapted to be screwed.

2. A slotted insert as claimed in Claim 1, wherein the spacing between the walls of the insert at its mouth is only slightly more than sufficient to allow the shank of the corresponding fixing bolt to pass out through said mouth.

3. A slotted insert as claimed in Claim 1 or 2, wherein the base of the insert is shaped so that its maximum depth is in the centre.

4. A slotted insert as claimed in Claim 3, wherein the base of the insert is of arcuate cross-section.

5. A slotted insert as claimed in any of the preceding claims, wherein the walls thereof are flanged outwardly at the mouth and then bent back at right angles in the general direction from the mouth to the base of the insert.

6. A slotted insert as claimed in Claim 5, wherein a cover strip is fitted over the mouth of the insert and is secured by its longitudinal marginal portions being bent over the bent back parts of the insert walls.

7. A fixing nut for use with an insert as claimed in any of the preceding claims, said fixing nut having each pair of opposite sides inclined at the same angle as the corresponding inclined wall surface parts of the insert and having the larger end surface recessed coaxially with its screw-threaded bore to receive a conical spiral spring.

8. A fixing bolt for use with an insert as claimed in any of Claims 1 to 6, said fixing bolt being provided with a head of substantially the same width but greater length than the diameter of the shank, the ends of the head being formed with inclined surfaces adapted to engage and mate with the inclined surface wall parts of the insert.

9. A fixing bolt as claimed in Claim 8, wherein the inclined end surfaces of the bolt head are also arranged obliquely with respect to the side surfaces of said bolt head.

10. A slotted insert of the kind referred to substantially as described with reference to Figures 1 to 4 of the accompanying drawings.

11. A slotted insert as claimed in Claim 10 provided with a cover strip as described with reference to Figures 9 and 10 of the accompanying drawings.

12. A fixing nut for use with a slotted insert as claimed in any of Claims 1 to 6 or 10 substantially as described with reference to Figures 1 to 5 of the accompanying drawings.

13. A fixing bolt for use with a slotted insert as claimed in any of Claims 1 to 6 or 10 substantially as described with reference to Figures 7 and 8 of the accompanying drawings.

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PROVISIONAL SPECIFICATION.

Improvements in or relating to Fixing Devices for Attaching Objects to Concrete Walls, Ceilings and the like.

WE, THE TRUSSED CONCRETE STEEL COMPANY LIMITED, a British Company, of 35-41 Lower Marsh, London, S.E.1, do hereby declare this invention to be described in the following statement: —

The present invention relates to fixing devices of the kind comprising a slotted insert in the form of a channel which is adapted to be embedded in concrete beams, columns, walls, ceilings, and the like with its mouth flush with and open to the exposed surface of the concrete and which provides an anchorage for bolt heads, nuts and like devices used for attaching objects to the wall, ceiling or the like in which the channel is embedded.

The invention is concerned with improvements in such slotted inserts and in bolts and nuts for use with them, as well as in fixing devices comprising both the inserts and the bolts or nuts.

According to this invention, there is provided an improved slotted insert of the kind referred to having walls which are parallel to one another or only slightly divergent for a substantial part of the depth of the insert commencing from the mouth thereof and thereafter diverging in the direction towards the base of the insert to provide divergent inclined abutment surfaces for correspondingly inclined mating surfaces on two opposite sides of a fixing-bolt head or on two opposite sides of a nut into which a fixing bolt is adapted to be screwed. The spacing between the walls of the insert at its mouth is preferably only slightly more than sufficient to allow the shank of the corresponding fixing bolt to pass out through said mouth. For example, this spacing may be between 10% and 30% greater than the diameter of the said shank.

The base of the insert is advantageously

shaped so that its maximum depth is in the centre, and in one preferred construction it is of arcuate cross-section.

The walls of the insert may be flanged outwardly at the mouth and then bent back at right angles in the general direction from the mouth to the base of the insert.

A fixing bolt for use with this insert may be provided with a head of substantially the same width but greater length than the diameter of the shank, the ends of the head being formed with inclined surfaces adapted to engage and mate with the inclined surface wall parts of the insert. This arrangement enables the bolt head, after being turned into a position in which its longer dimension is parallel with the length of the insert, to be introduced into the insert through the mouth of the latter and, when inserted therein to a sufficient depth, to be turned through a substantial angle so that its inclined surfaces can be engaged with those of the insert.

The depth of the slot can be reduced, and the angle through which the bolt must be turned to ensure correct mating of its inclined surfaces with those of the insert can be more easily judged, if the inclined surfaces on the bolt head are disposed so that their top and bottom edges are parallel to one another and at an oblique angle to the sides of the bolt head.

A nut for use with this insert has each pair of opposite sides inclined at the same angle as the corresponding inclined wall surface parts of the insert and has the larger end surface recessed coaxially with its screw-threaded bore to receive a conical spiral spring. The combined depth of the nut and spring, when the latter is fully compressed, is slightly less than the width of the mouth of the insert. The nut, with the spring fully compressed, can thus be inserted side-foremost through the mouth of the insert and, when it is near the base end of the insert, turned over and adjusted into a position in which two opposite inclined side surfaces thereof engage the inclined side wall parts of the insert, the smaller diameter end of the spring being adapted to slide over the curved inside surface of the insert as the nut is turned over.

After being inserted in this manner, the fixing nut or bolt can be slid along the slotted insert to any desired position.

A preferred embodiment of the invention will now be described by way of example as applied to a slotted insert for $\frac{3}{8}$ in. diameter fixing bolts.

The slotted insert according to this embodiment has the form of a channel having two parallel wall parts spaced $\frac{1}{2}$ in. apart extending inward, from the mouth towards the base of the channel, a distance of $\frac{1}{2}$ in. Thereafter the walls of the channel diverge at a mutual angle of 35° in the direction towards the base of the channel and for a distance of approximately 1 in. before joining the base of the channel which is of curved cross-section with a concave surface on the inside of the channel. The overall depth of the channel is approximately $1\frac{5}{8}$ in.

At the mouth of the channel are formed two outwardly directed $\frac{1}{2}$ in. flanges, the outer margins of which are bent back for a distance of about $\frac{1}{8}$ in. in the general direction from the mouth towards the base of the channel.

This slotted insert is adapted to be embedded in a concrete wall, ceiling or the like or in a concrete building block so that the outwardly directed flanges at its mouth are flush with the exposed surface of the concrete. The embedding of the slotted insert in the concrete in this manner is facilitated by the above-mentioned flanges which enable the insert to be secured tightly by means of clout nails, dog spikes or the like against the shuttering upon which the concrete is cast, the heads of the clout nails, dog spikes or the like engaging over the bent back margins of the outwardly directed flanges on the insert.

If desired the slotted insert may be provided at intervals along its length with stirrups having $1\frac{1}{2}$ in. long 1 in. wide arms diverging in the direction away from the mouth of the insert and fixed to the base of the latter. The extremities of these arms may be provided with right angle bent parts approximately $\frac{1}{2}$ in. long.

In a fixing bolt intended to be anchored by its head in this insert, the said head is in the form of a cross-piece, $\frac{3}{8}$ in. wide and approximately 1 in. in overall length. On both ends of the cross-piece are inclined surfaces which converge in the direction towards the shank of the bolt at the same angle as the inclined wall parts of the slotted insert. These inclined end surfaces are also arranged obliquely so that the top edges of the cross-piece form a parallelogram having two opposite angles of 100° and the other two of 80°.

In order to engage this fixing bolt in the slotted insert, it is first turned until the longer side surfaces of its head are parallel to the centre line of the slotted insert. The head of the fixing bolt is then introduced through the mouth of the slotted insert and turned with the larger angles of the above-mentioned parallelogram foremost until the inclined end surfaces of the head are parallel with the inclined wall surface parts of the slotted insert. Lastly the fixing bolt head is withdrawn axially a short distance towards the mouth until its inclined end surfaces are seated on the inclined wall surface parts of the slotted insert.

A four-sided fixing nut for anchoring in the same slotted insert has all four sides

inclined inward from top to bottom at the same angle as the inclined wall surface parts of the slotted insert. This nut is $\frac{15}{16}$ in. square at the top and $\frac{3}{4}$ in. square at the bottom and its thickness at each side is approximately $\frac{5}{16}$ in. The top surface of the nut is dome-shaped but with its centre part bored out to provide a slightly recessed annular seating coaxially surrounding the screw-threaded bore of the nut. Engaged in this recessed annular seating is the larger end of a conical spiral spring.

This fixing nut can be inserted into the slotted insert by first turning the nut into a position in which its bottom surface is parallel to the parallel wall parts of the insert and then, after compressing the spring, inserting the nut side-foremost through the mouth of the insert. When the nut is close to the base of the insert, it is turned over and adjusted into a position in which two of its opposite inclined side surfaces are parallel to the inclined side wall parts of the insert. During this operation, the smaller diameter end of the spring slides over the curved inside surface of the insert and assists in adjusting the nut into position and thereafter, when the nut is released, the spring will urge the nut into a position in which the said two inclined side surfaces thereof mate with the inclined side wall surfaces of the insert.

Although this nut can be slid lengthwise along the slotted insert, after being inserted therein as described above, its spring operates to maintain sufficient frictional resistance to such sliding movement to prevent movement of the nut under its own weight if the slotted insert were to be embedded in a vertical position.

In order to facilitate the manipulation of the nut during its insertion into the slotted insert, shallow recesses may be formed in the upper central area of each of the sloping sides of the nut for engagement by projections on jaws or the like of a tool. A suitable tool is formed of spring wire bent in the middle to form a one-and-a-half turn coil from which the end portions of the wire project to form two similarly directed but slightly divergent arms which constitute the jaws of the tool.

The extremities of these arms are bent towards one another to form the above-mentioned projections for engagement with the recesses in the nut. In use, after inserting the nut into, and positioning it within, the slotted insert with the aid of this tool, the latter is disengaged from the nut and withdrawn.

The slotted insert described above, instead of being embedded in a cast-*in-situ* concrete beam, column, wall, ceiling or the like, may if desired be embedded in a building block the dimensions of which enable it to be incorporated horizontally or vertically in brickwork.

A high load-carrying capacity is achieved in practice with this slotted insert, due to the fact the inclined abutment surfaces are set back from the exposed surface of the concrete by an amount equal to the distance that the parallel sided wall parts extend inward from the mouth of the insert in the direction towards the base thereof. It is also an easy matter to match the load-carrying capacity of the insert with the strength of the fixing device, i.e. the fixing bolt or fixing nut, used therewith.

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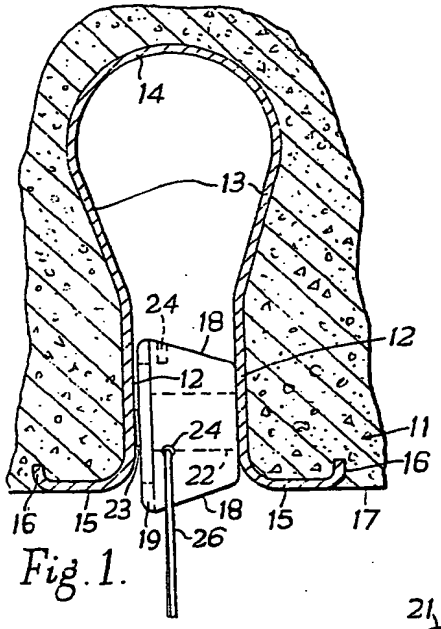


Fig.1.

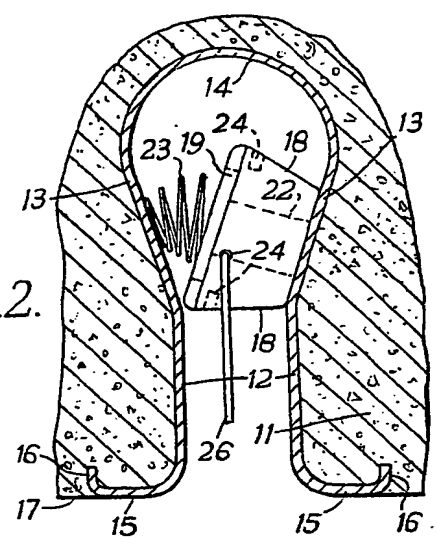


Fig.2.

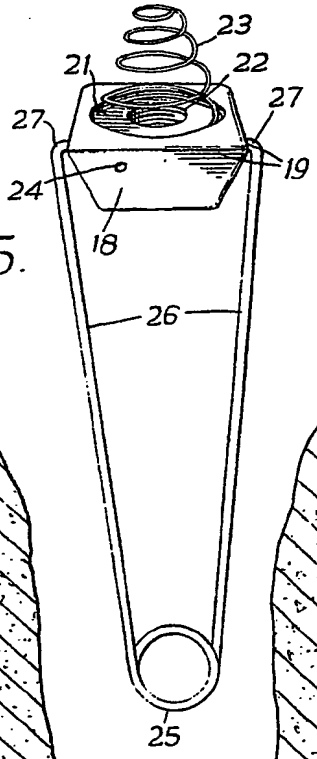


Fig.5.

Fig.3.

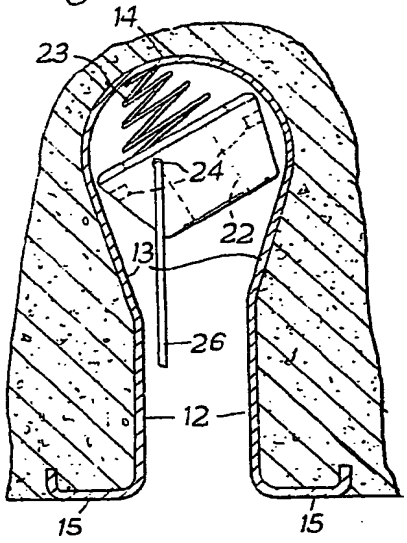
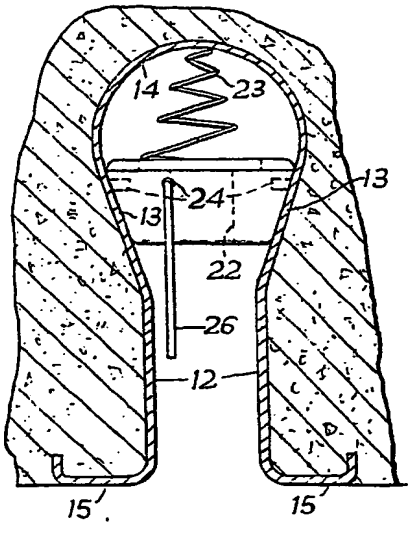
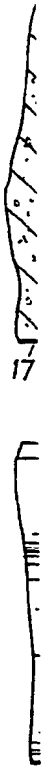


Fig.4.





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2 SHEETS

COMPLETE SPECIFICATION

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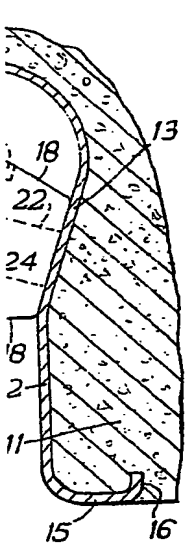
Sheets 1 & 2



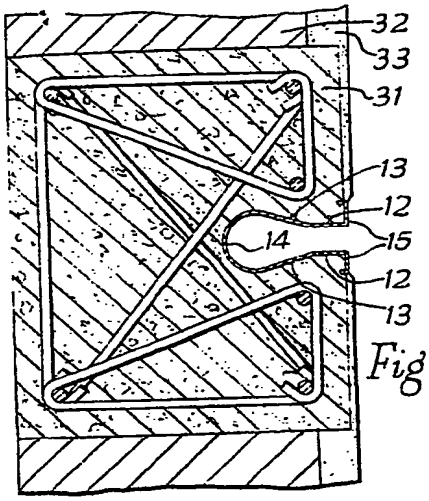


Fig.6.

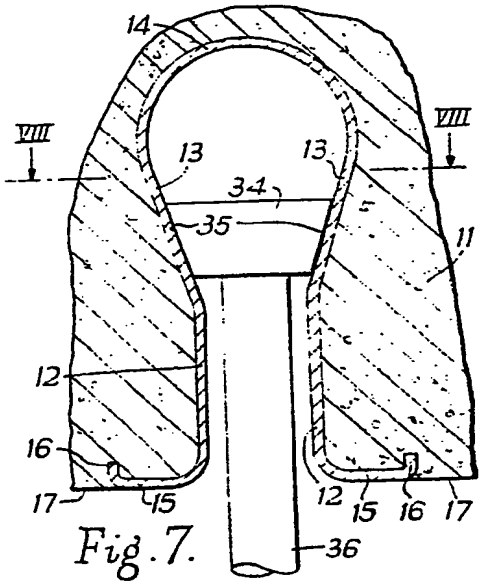


Fig.7.

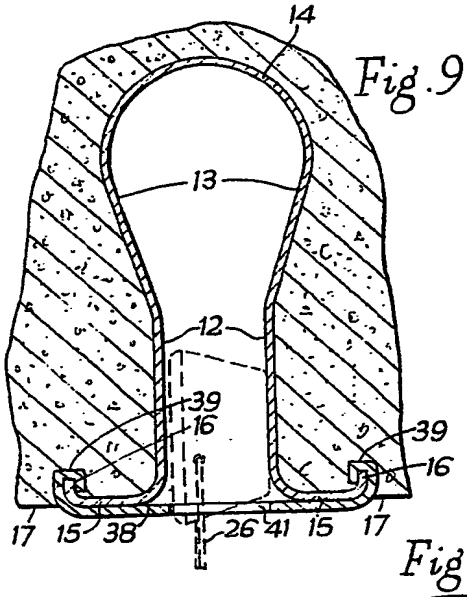


Fig.9.

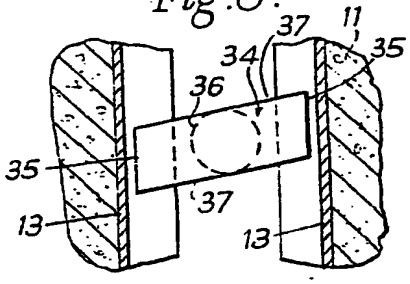


Fig.8.

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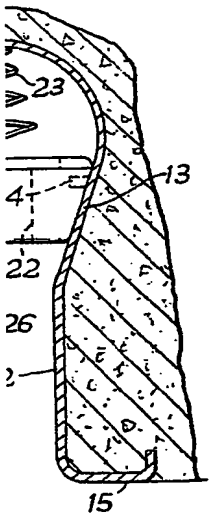
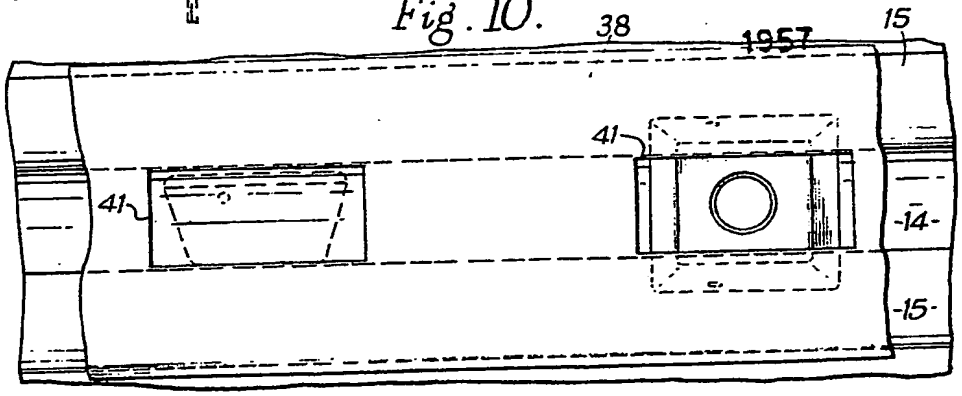


Fig.10.



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Sheets 1 & 2

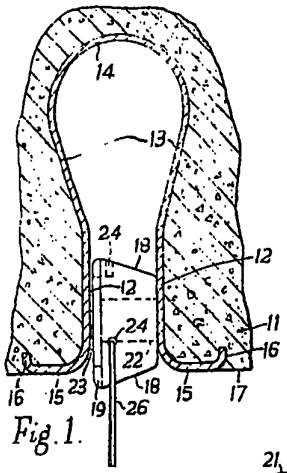


Fig.1.

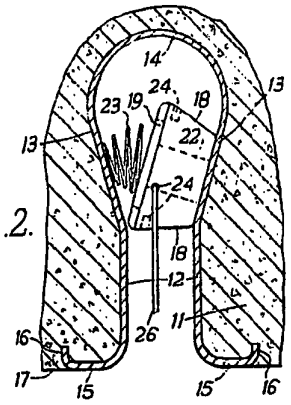
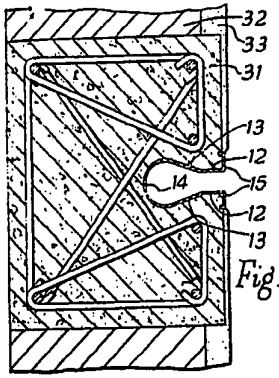


Fig.2.



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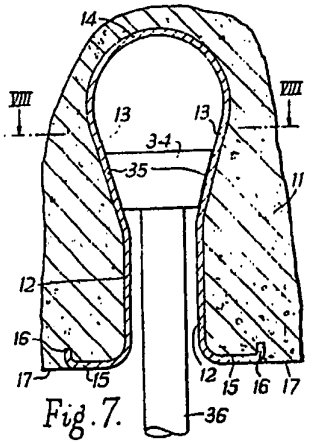


Fig.7.

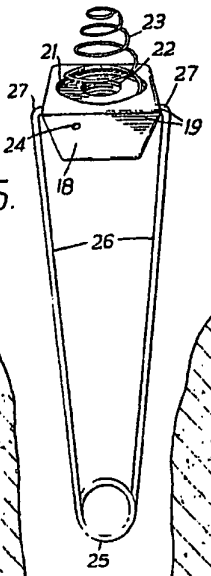
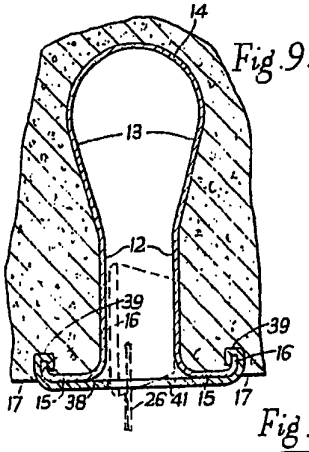


Fig.5.



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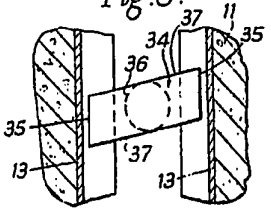

Fig.8.

Fig.3.

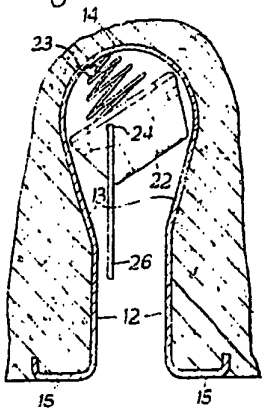

Fig.4.

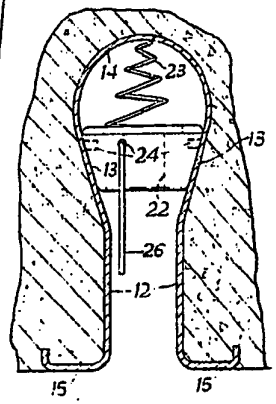

Fig.10.